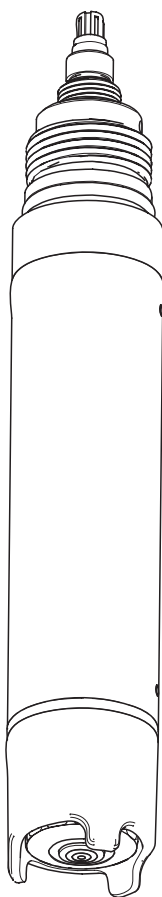


Operating Instructions

OOS31

Dissolved oxygen sensor



Brief overview

Here is how to use these Operating Instructions to commission your sensor quickly and safely:

Page 4 ff. Page 5	Safety instructions General safety instructions Explanation of the warning symbols You can find special instructions at the appropriate position in the chapter in question. The positions are indicated with the icons Warning ⚠, Caution ⚡ and Note 📌.
	▼
Page 7 ff. Page 10 ff.	Installation Here you can find installation conditions such as sensor dimensions and the angle of installation. Installation examples can be found here.
	▼
Page 14 ff.	Wiring Refer to these pages for sensor wiring.
	▼
Page 16 Page 17 ff. Page 17 ff.	Sensor design and measuring principle Here you can read about the sensor design. The measuring principle is explained on this page. Here you can find the possible calibration methods.
	▼
Page 20 ff.	Commissioning The sensor must be polarised before calibration. Please, read on the given page how to do it.
	▼
Page 22 ff. Page 23 ff. Page 28	Maintenance It is absolutely essential to carry out maintenance tasks on a regular basis. Individual parts are subject to normal wear and tear. Here you can find out how to replace such parts. Here you can find an overview of the spare parts which can be delivered as well as an overview of the system.
	▼
Page 26 ff.	Trouble-shooting If faults occur during operation, use the checklist to locate the cause.
	▼ ▼
Page 32 ff.	Index You can find important terms and keywords on the individual sections here. Use the keyword index to find the information you need quickly and efficiently.

Table of contents

1	Safety instructions	4	9.3	Spare parts	28
1.1	Designated use	4	9.4	Return	28
1.2	Installation, commissioning and operation	4	9.5	Disposal	29
1.3	Operational safety	4			
1.4	Return	4	10	Technical data	30
1.5	Notes on safety icons and symbols	5	10.1	Input	30
2	Identification	6	10.2	Performance characteristics	30
2.1	Product structure	6	10.3	Environment	30
2.2	Scope of delivery	6	10.4	Process	30
3	Installation	7	10.5	Mechanical construction	31
3.1	Incoming acceptance, transport, storage	7			
3.2	Installation conditions	7	Index		32
3.3	Installation instructions	8			
3.4	Installation examples	10			
3.5	Post-installation check	13			
4	Wiring	14			
4.1	Direct connection to the transmitter	14			
4.2	Connection via junction box	15			
4.3	Post-connection check	15			
5	Operation	16			
5.1	Sensor design	16			
5.2	Measuring principle	17			
5.3	Calibration	17			
6	Commissioning	20			
6.1	Function check	20			
6.2	Polarisation	20			
6.3	Calibrate	21			
7	Maintenance	22			
7.1	Cleaning the sensor	22			
7.2	Regenerating the sensor	23			
8	Accessories	25			
8.1	Connection accessories	25			
8.2	Installation accessories	25			
8.3	Measurement, controlling and sensor cleaning	25			
9	Trouble-shooting	26			
9.1	Trouble-shooting instructions	26			
9.2	Sensor checks	27			

1 Safety instructions

1.1 Designated use

The oxygen sensor is suitable for continuous measurement of dissolved oxygen in water.

Typical applications are:

- Measuring oxygen content in activated sludge basins.
The measuring signal is used for monitoring and as a control parameter.
- Checking oxygen content in the outlet of a sewage treatment plant.
- Measuring and controlling the oxygen content in fish farming water.
- Oxygen enrichment in drinking water.

Any other use than the one described here compromises the safety of persons and the entire measuring system and is, therefore, not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

1.2 Installation, commissioning and operation

Please note the following items:

- Installation, electrical connection, commissioning, operation and maintenance of the measuring system must only be carried out by trained technical personnel.
The technical personnel must be authorised for the specified activities by the system operator.
- Technical personnel must have read and understood these Operating Instructions and must adhere to them.
- Before commissioning the entire measuring point, check all the connections for correctness. Ensure that electrical cables and hose connections are not damaged.
- Do not operate damaged products and secure them against unintentional commissioning. Mark the damaged product as being defective.
- Measuring point faults may only be rectified by authorised and specially trained personnel.
- If faults can not be rectified, the products must be taken out of service and secured against unintentional commissioning.
- Repairs not described in these Operating Instructions may only be carried out at the manufacturer's or by the service organisation.

1.3 Operational safety

The sensor has been designed and tested according to the state of the art and left the factory in perfect functioning order.

Relevant regulations and European standards have been met.

As the user, you are responsible for complying with the following safety conditions:

- Installation instructions
- Local prevailing standards and regulations.

1.4 Return

If the device requires repair, please send it *cleaned* to the sales centre responsible. Please use the original packaging, if possible.

Please enclose the completed "Declaration of contamination" (copy the second last page of these Operating Instructions) with the packaging and the transportation documents.

No repair without completed "Declaration of contamination"!

1.5 Notes on safety icons and symbols



Warning!

This symbol alerts you to hazards. They can cause serious damage to the instrument or to persons if ignored.



Caution!

This symbol alerts you to possible faults which could arise from incorrect operation. They could cause damage to the instrument if ignored.



Note!

This symbol indicates important items of information.

2 Identification

2.1 Product structure

Certificate			
	A	Ex free version	
Cable length			
	0	Cable length: 1.5 m (4.92 ft)	
	2	Cable length: 7 m (22.97 ft)	
	4	Cable length: 15 m (49.22 ft)	
	8	Without Cable (TOP 68 version only)	
	9	Special design to customer specifications	
Cable connection			
	F	Fixed cable connection	
	S	Cable connection using TOP 68 plug	
Membrane cap			
	1	OOY31-WP membrane cap, minimum flow rate 5 mm/s, for normal response time	
	2	OOY31-S-WP membrane cap, minimum flow rate 25 mm/s, for fast response time	
OOS31-			Complete order code

2.2 Scope of delivery

The following items are included in the delivery:

- Oxygen sensor with transport protection cap for membrane protection
- Accessories Set with the following contents:
 - 2 replacement cartridges (replacement membrane caps)
 - 10 plastic ampoules containing electrolyte
 - 1 sealing kit with 3 O-rings
 - 6 abrasive sheets
- Operating Instructions english

If you have any questions, please contact your supplier or your sales centre responsible .

3 Installation

3.1 Incoming acceptance, transport, storage

- Make sure the packaging is undamaged!
Inform the supplier about damage to the packaging.
Keep the damaged packaging until the matter has been settled.
- Make sure the contents are undamaged!
Inform the supplier about damage to the delivery contents.
Keep the damaged products until the matter has been settled.
- Check that the scope of delivery is complete and agrees with your order and the shipping documents.
- The packaging material used to store or to transport the product must provide shock protection and humidity protection. The original packaging offers the best protection. Also, keep to the approved ambient conditions (see "Technical data").
- If you have any questions, please contact your supplier or your sales centre responsible.

3.2 Installation conditions

3.2.1 Dimensions

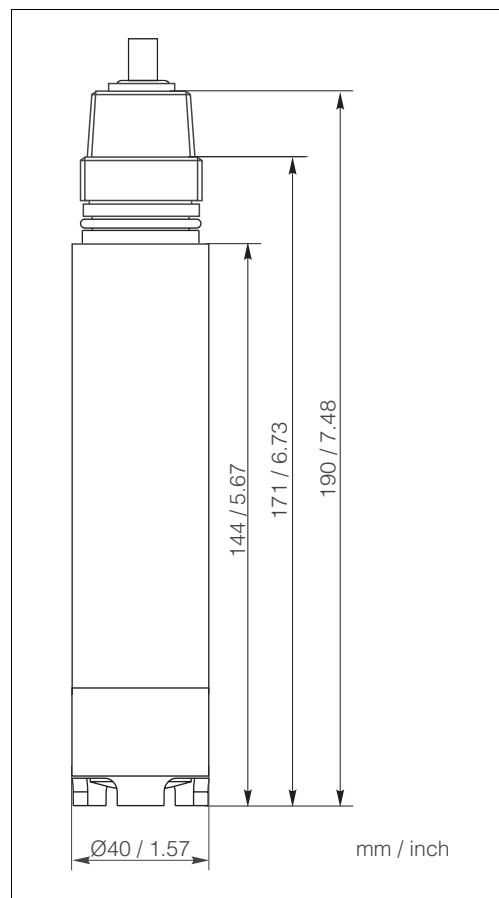


Fig. 1: Fixed cable version

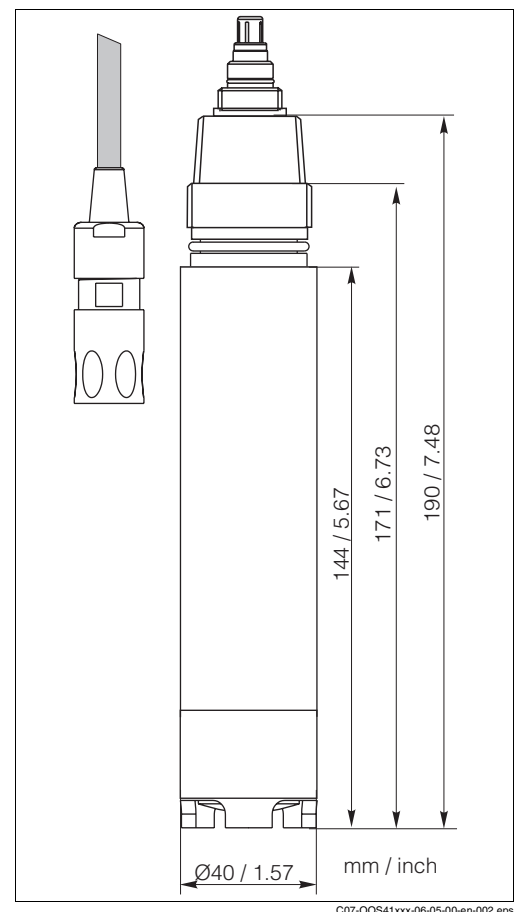
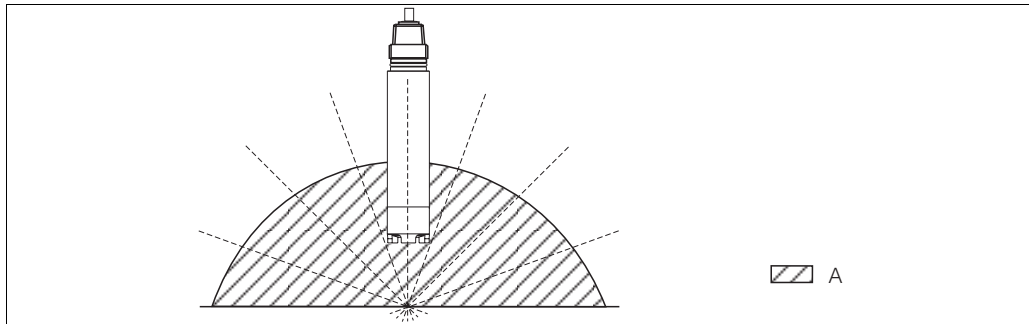


Fig. 2: TOP 68 plug-in head version

3.2.2 Angle of installation

The sensor can be installed up to the horizontal in an assembly, support or a suitable process connection (Fig. 3). Other angles are not permissible. Do **not** install the sensor overhead.



C07-OOS41xxx-11-05-00-xx-001.eps

Fig. 3: Angle of installation

A Permissible installation positions: 0 ... 180 °, overhead installation is not permitted



Note!

Make sure you comply with the instructions for installing sensors. You will find them in the Operating Instructions for the assembly used.

3.2.3 Installation place

- Select the installation location so that there is easy access for later calibration.
- Make sure that upright posts and assemblies are secured safely and vibration-free.
- For immersed operation in an activated sludge basin, select an installation location which produces a typical oxygen concentration.

3.3 Installation instructions

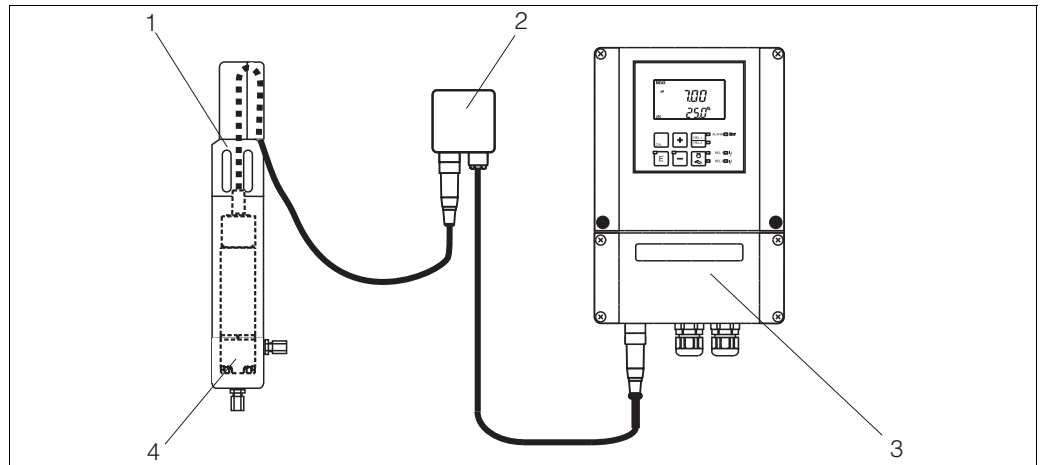
3.3.1 Measuring system

A complete measuring system comprises at least:

- Oxygen sensor
- Transmitter, e.g. OOM223/253
- Special measuring cable
- Assembly, e.g. flow assembly OOA250, immersion assembly OOA110 or retractable assembly OOA451

Optional:

- Universal suspension assembly support OOH 101 for immersed operation
- Junction box VS (with cable extension)
- Automatic spray cleaning system



C07-00S71xxx-14-05-00-xx-001.eps

Fig. 4: Measuring system (example)

- 1 Flow assembly
- 2 Junction box VS (optional)
- 3 Transmitter OOM253
- 4 Oxygen sensor

3.3.2 Installing a measuring point



Note!

For immersed operation, install the individual modules away from the basin on a solid base. Only carry out the final installation at the intended installation location.

For a complete installation of a measuring point, proceed as follows:

1. Install a retractable or a flow assembly (if used) into the process.
2. Connect the water supply to the rinse connections (if you use an assembly with cleaning function).
3. Install and connect the oxygen sensor.
4. Install an immersion or an suspension assembly (if used) into the process.



Caution!

- For immersed operation, the sensor must be installed in an immersion assembly (e.g. OYA 611). **Do not install the sensor suspended from the cable.**
- Screw the sensor into the assembly so that the cable is not twisted.
- Avoid exerting excessive tensile force on the cable (e.g. from jerky pulling).
- Select the installation location so that there is easy access for later calibration.

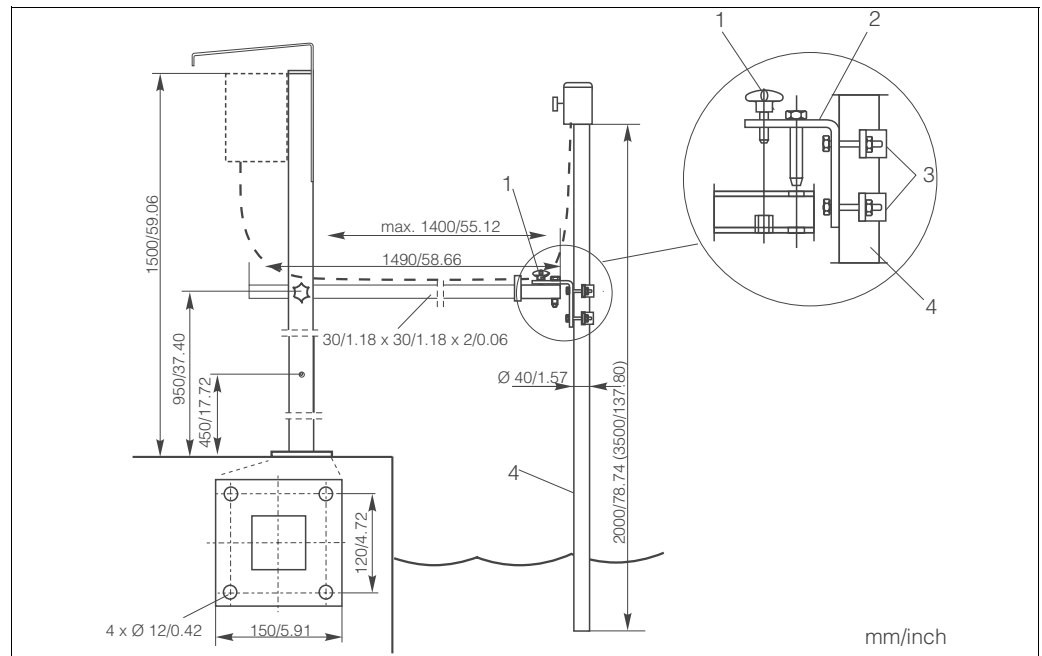


Warning!

When using metallic assemblies and installation equipment, comply with national grounding regulations.

Upright post and fixed immersion assembly

The preferable type of installation for strong or turbulent flow ($> 0.5 \text{ m/s}$) in the basin or open channels is to secure the device to an upright post and a securely mounted immersion tube (Fig. 7). If the flow is very strong, a second transverse pipe can be installed with its own pipe support.



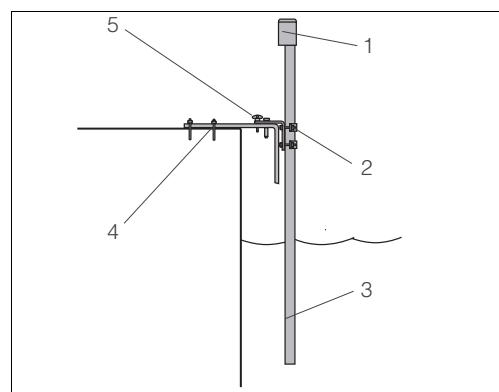
C07-OOS41xxx-11-05-00-en-003.eps

Fig. 7: Universal suspension assembly holder with immersion assembly

- 1 Star handle
- 2 Pipe holder
- 3 Fixing bracket
- 4 Immersion assembly (= immersion tube)

Basin rim mounting

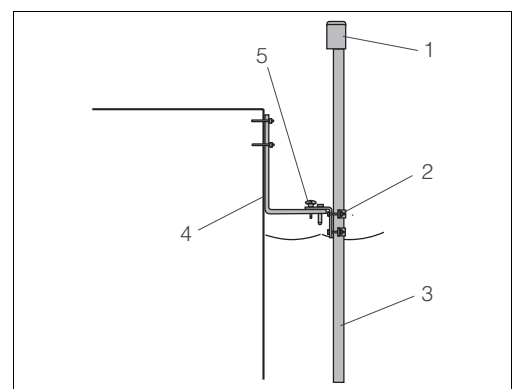
For fixing to the sides of the basin or channel, we recommend the use of a basin rim mounting of the immersion assembly (Fig. 8, Fig. 9).



C07-OOS41xxx-11-05-00-xx-005.eps

Fig. 8: Horizontal basin rim mounting

- 1 Protection cover for cable entry
- 2 Assembly holder
- 3 Immersion assembly SS 1.4301 (AISI 304)



C07-OOS41xxx-11-05-00-xx-006.eps

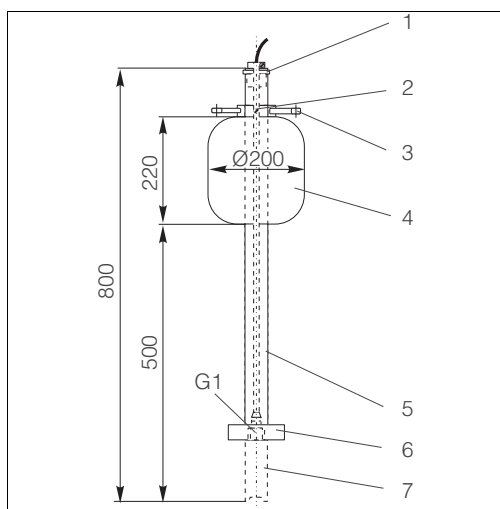
Fig. 9: Vertical basin rim mounting

- 4 Basin rim mounting
- 5 Star handle

If there is strong turbulence or flow, a second basin rim mounting must be used for the immersion assembly.

Floating body

To aid installation in strongly fluctuating water levels, e.g. in rivers or lakes, there is a floating body OOA 110-50 available (Fig. 10).



- 1 Cable route with strain relief and rain protection
- 2 Mounting ring for ropes and chains with locking screw
- 3 Lugs Ø 15; 3x120° for anchoring
- 4 Saltwater-resistant plastic float
- 5 Pipe 40x1, rust-proof steel SS 1.4571 (AISI 316Ti)
- 6 Shock absorber and weight
- 7 Oxygen sensor

Fig. 10: Floating body

3.4.2 Flow operation

The OOA 250-A flow assembly (Fig. 11) with automatic self-venting is suitable for use in pipelines or hose connections. The inlet is at the bottom of the assembly, the outlet at the top (connection thread G 3/4). It can be installed in a pipe by using two 90° pipe brackets to allow inflow to the assembly (Fig. 12, Pos. 6).

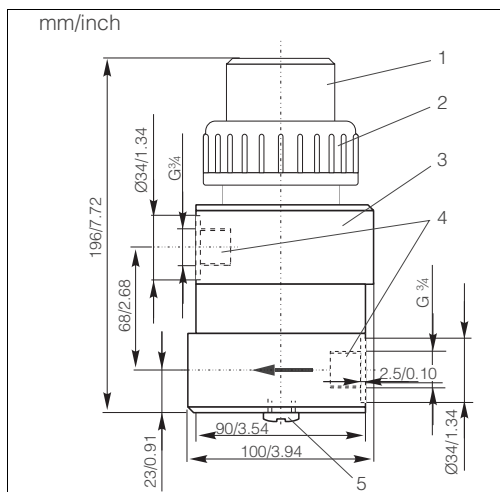


Fig. 11: Flow assembly OOA 250-A

- 1 Screw-in part for sensor
- 2 Screw ring
- 3 Meter body
- 4 Connection thread G 3/4
- 5 Dummy plug (connection for spray head COR 3)

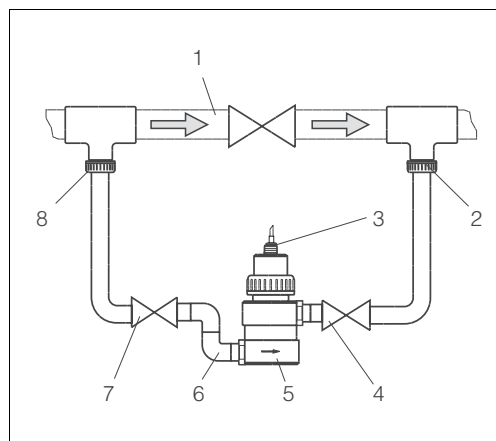


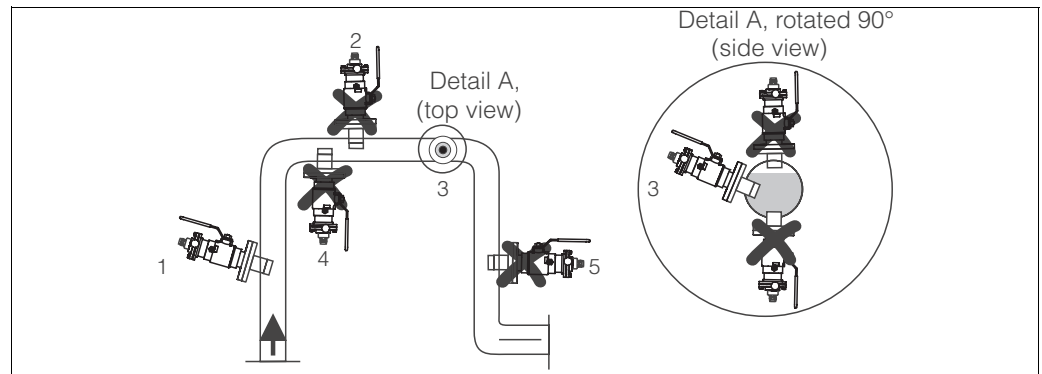
Fig. 12: Bypass installation with manually actuated valves or solenoid valves

- 1 Main line
- 2 Medium return
- 3 Oxygen sensor
- 4, 7 Manually actuated or solenoid valves
- 5 Flow assembly OOA 250-A
- 6 90° pipe bracket
- 8 Medium removal

3.4.3 Retractable assembly

The assembly is designed for installation on tanks and pipes. Suitable nozzles must be available for this.

Install the assembly at places with constant flow. The minimum pipe diameter is DN 80.



C07-00A451xx-11-07-00-en-001.eps

Fig. 13: Permissible and impermissible sensor installation positions

- 1 Ascending pipe, best position
- 2 Horizontal pipe, sensor top down, impermissible due to air cushion or foam bubble forming
- 3 Horizontal pipe, installation with permissible emitting angles (acc. to sensor version)
- 4 Overhead installation, impermissible due to missing electrolyte contact of the sensor electrodes
- 5 Down pipe, impermissible



Note!

- Do not install the assembly at places, where air cushions or foam bubbles can be formed or where suspended particles can settle on the sensor optics (→ Fig. 13).
- Measuring errors can occur, if:
 - the sensor is not immersed into the medium
 - suspended particles are settled on the sensor membrane
 - the sensor is installed overhead.

3.5 Post-installation check

- Check the membrane for leak tightness und replace it if necessary.
- Compliance with permissible sensor installation position?
- Is the sensor installed to an assembly and is not suspended from the cable?
- Avoid moisture by rain by fitting the protective cap to the immersion assembly?

4 Wiring



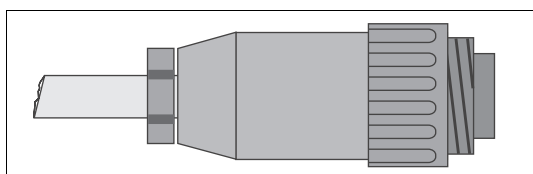
Warning!

- The electrical connection must only be carried out by authorised technical personnel.
- Technical personnel must have read and understood the instructions in this manual and must adhere to them.
- Ensure that there is no voltage at the power cable before beginning the connection work.

4.1 Direct connection to the transmitter

The sensor connection is different acc. to the transmitter version:

- Field device (OOM253):
Connect the sensor directly to the transmitter by using the special measuring cable with SXP plug.



C07-OOS41xxx-04-05-00-xx-001.eps

Fig. 14: SXP plug

- Panel mounted device (OOM223):
 - Please, remove the SXP plug (transmitter side!) from the cable.
 - Take out the cable specification and the corresponding pins of OOM223 from the following table.

Please note, that the cable specification differs acc. to the sensor version (fixed cable or TOP68 plug-in connection).

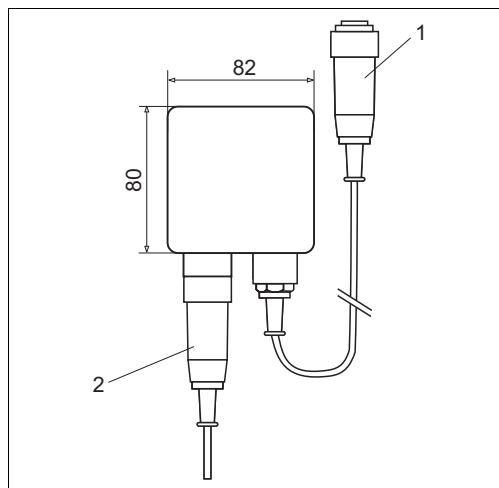
Pin of OOM223	Sensor with fixed cable (OMK)		Sensor with TOP68 plug-in head (CYK71)	
	Colour	Assignment	Colour	Assignment
87	yellow	+U _B	yellow	+U _B
0	grey	OV	white	OV
96	pink	NTC (analogue) or comm. (digital)	green	Communication (digital)
97	blue	NTC (analogue) or comm. (digital)	brown	Communication (digital)
88	brown	–U _B	COAx inner	–U _B
19	green	Alarm		
18	white	Sensor signal		

4.2 Connection via junction box

To lengthen the sensor connection beyond the length of the fixed cable, you require a junction box VS (Fig. 15, Fig. 16).

Always connect the sensor cable with the SXP plug to the junction box.

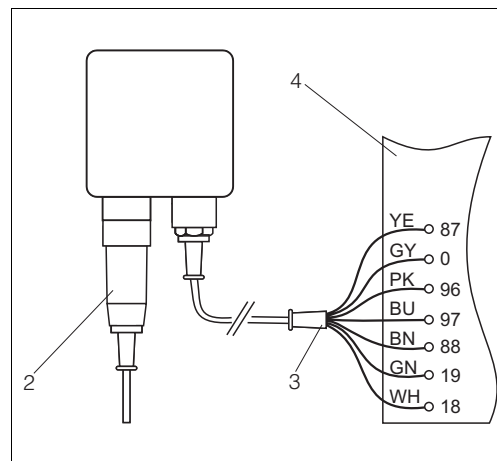
The cable extension to the transmitter then depends from the transmitter version, i.e. field device or panel mounted device.



C07-OOS31xxx-04-05-00-de-001.eps

Fig. 15: Junction box VS to a field device

- 1 SXP plug to field device
- 2 SXP plug from sensor



C07-OOS31xxx-04-05-00-xx-002.eps

Fig. 16: Junction box VS to a panel mounted device

- 2 SXP plug from sensor
- 3 Measuring cable (OMK) to the transmitter
- 4 Connection department of the transmitter

4.3 Post-connection check

Instrument status and specifications	Remarks
Are the sensor, assembly, junction box or cable damaged?	Visual inspection
Electrical connection	Remarks
Does the supply voltage of the transmitter match the specifications on the nameplate?	110/230 V AC 24 V AC/DC
Are the installed cables strain-relieved and not twisted ?	
Is the cable type route completely isolated ?	Power cable/weak current cable
Are the power supply and signal cable correctly connected to the transmitter ?	Use the connection diagram of OOM 2x3.
Are all the screws terminals properly tightened ?	
Are all the cable entries installed, tightened and sealed ?	For cable entries lateral: cable loops downwards for water to be able to drip off.
Are all the cable entries installed downwards or lateral ?	

5 Operation

5.1 Sensor design

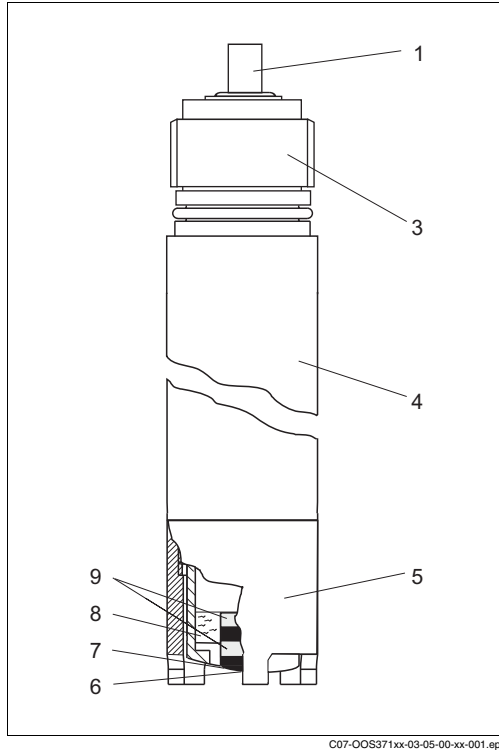


Fig. 17: Sensor design

- 1 Sensor cable
- 3 Threaded connection G1
- 4 Sensor shaft
- 5 Protection basket
- 6 Cathode
- 7 Membrane
- 8 Electrolyte
- 9 Anode

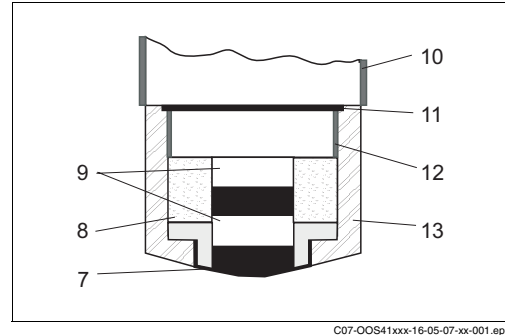


Fig. 18: Sensor head, cutaway drawing

- 7 Membrane
- 8 Electrolyte
- 9 Anode
- 10 Threaded connection for protection basket
- 11 Sealing ring
- 12 Threaded connection for membrane cap
- 13 Membrane cap

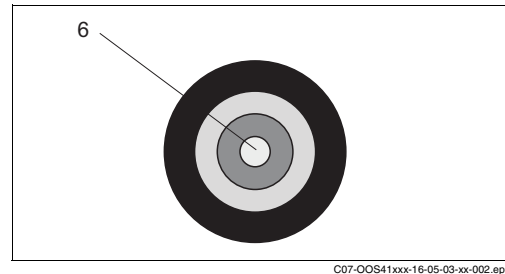


Fig. 19: Sensor head, top view

- 6 Cathode

The sensor consists of the following function units:

- Sensor shaft (Fig. 17, pos. 4)
- Sensor head with cathode and anode (Fig. 18, Fig. 19)
- Membrane cap with electrolyte filling (Fig. 18, pos. 13 and 8)
- Protection basket (Fig. 17, pos. 5)



Note!

- Alternatively to the protection basket, you can use a spray head OOR 3 (optional, see "Accessories") for use in immersed operation with cleaning function.
- The membrane cap screwed onto the sensor head is filled with electrolyte. The screw connection seals it from the medium.
- The membrane which is in contact with the medium is pretensioned in the factory.

5.2 Measuring principle

5.2.1 Polarisation

When the sensor is connected to the transmitter, a fixed external voltage is applied between the cathode and anode. The resulting polarisation current is indicated on a display on the transmitter. The current starts high but then drops over time. The sensor can only be calibrated when the display is stable.

5.2.2 Membrane

The oxygen dissolved in the medium is conveyed to the membrane by the incoming flow. The membrane is only permeable for dissolved gases. Other substances dissolved in the liquid phase e.g. ionic substances, will not penetrate through the membrane. Therefore, medium conductivity has no impact on the measuring signal.

5.2.3 Amperometric principle

The oxygen molecules diffused through the membrane are reduced to hydroxide ions (OH^-) at the cathode. Silver is oxidised to silver ions (Ag^+) at the anode (this forms a silver bromide layer, AgBr).

A current flows due to the connected electrode release at the cathode and accepted at the anode. In equilibrium, this flow is proportional to the oxygen content of the medium. This current is converted in the measuring instrument and indicated on the display as an oxygen concentration in mg/l, as a saturation index in % SAT or as an oxygen partial pressure in hPa.

5.3 Calibration

Calibration is a means of adapting the transmitter to the characteristic values of the sensor. As no zero calibration is required for the sensor, a single-point calibration is carried out in the presence of oxygen.

The sensor requires calibration after:

- first commissioning
- replacing a membrane or electrolyte
- cleaning the cathode
- long breaks in operation without power supply
- typical time intervals dependent on operating experience

There are three basic types of calibration:

- in air (preferably saturated water vapour, e.g. near the water surface)
- in air-saturated water
- by entering a reference measured value in the transmitter (sensor remains in the medium).



Note!

Following **only** the calibration in air is described because it is the easiest and that's why the recommended method of calibration.

Calibration in air is only possible if air temperature $\geq -5\text{ }^{\circ}\text{C}$.

5.3.1 Calibration in air

1. Remove the sensor from the medium.
2. Clean the outside of the sensor with a damp cloth. Then dry the sensor membrane e.g. by using a tissue.
3. If the sensor is removed from a closed pressure system with a process pressure greater than atmospheric pressure:
 - Open the membrane cap to equilibrate the pressure and clean the cap if necessary.
 - Replace the electrolyte filling and close the membrane cap again.
 - Wait for the polarisation time to end.
4. Then wait while the sensor adjusts to the temperature of the ambient air. This takes about 20 minutes. Check that the sensor is not in direct sunlight during this time.
5. If the measured value display on the transmitter is stable, carry out the calibration in accordance with the Operating Instructions of the transmitter.
6. Place the sensor in the medium again.



Note!

Make sure you comply with the instructions for calibration in the Operating Instructions of the transmitter.

5.3.2 Calculation example for the calibration value

As a check, you can calculate the expected calibration value (transmitter display) as shown in the following example (salinity is 0).

1. Determine:
 - the sensor temperature (ambient air)
 - the altitude above sea level
 - the current air pressure (=rel. air pressure to sea level) at the time of calibration. (If undeterminable, use 1013 hPa for an approximate calculation.)
2. Define:
 - the saturation value **S** acc. to the first table
 - the factor **K** acc. to the second table

°C	S [mg/l]
0	14.64
1	14.23
2	13.83
3	13.45
4	13.09
5	12.75
6	12.42
7	12.11
8	11.81
9	11.53
10	11.25

°C	S [mg/l]
11	10.99
12	10.75
13	10.51
14	10.28
15	10.06
16	9.85
17	9.64
18	9.45
19	9.26
20	9.08

°C	S [mg/l]
21	8.90
22	8.73
23	8.57
24	8.41
25	8.25
26	8.11
27	7.96
28	7.82
29	7.69
30	7.55

°C	S [mg/l]
31	7.42
32	7.30
33	7.18
34	7.06
35	6.94
36	6.83
37	6.72
38	6.61
39	6.51
40	6.41

Altitude [m]	K	Altitude [m]	K	Altitude [m]	K	Altitude [m]	K
0	1.000	550	0.938	1050	0.885	1550	0.834
50	0.994	600	0.932	1100	0.879	1600	0.830
100	0.988	650	0.927	1150	0.874	1650	0.825
150	0.982	700	0.922	1200	0.869	1700	0.820
200	0.977	750	0.916	1250	0.864	1750	0.815
250	0.971	800	0.911	1300	0.859	1800	0.810
300	0.966	850	0.905	1350	0.854	1850	0.805
350	0.960	900	0.900	1400	0.849	1900	0.801
400	0.954	950	0.895	1450	0.844	1950	0.796
450	0.949	1000	0.890	1500	0.839	2000	0.792
500	0.943						

3. Determine:
 - **L** = rel. air pressure at calibration (1013 hPa if unknown)
 - **M** = 1.02 for calibration in air resp. 1.00 for calibration in air-saturated water
4. Calculate the calibration value **C**:

$$C = S \cdot K \cdot L \cdot M$$

Example

- Air calibration at 18°C, altitude 500 m above sea level, air pressure 1022 hPa
- $S = 9.45 \text{ mg/l}$, $K = 0.943$, $L = 1.0089$, $M = 1.02$

Calibration value $C = 9.17 \text{ mg/l}$.

6 Commissioning

6.1 Function check

Before first commissioning, check if:

- the sensor is correctly installed
- the electrical connection is correct.

If using an assembly with automatic cleaning, check the correct water connection at the assembly rinse connection.



Warning!

Danger of medium leaking off

Before applying compressed air to an assembly with cleaning facility, make sure the connections are correctly fitted. Otherwise, the assembly may not be insert into the process.

6.2 Polarisation

The sensor was tested in the factory for perfect functionality and is supplied ready for operation.

To prepare for calibration, proceed as follows:

1. Remove the sensor protective cap.
2. Place the externally dry sensor in atmospheric air. The air should be saturated with water vapour. Therefore, install the sensor as close to the water surface as possible. When calibrating the sensor membrane, make sure the membrane remains dry. Therefore, avoid any direct contact with the water surface.
3. Connect the sensor to the transmitter and switch on the transmitter.
4. Switch-on the transmitter.
If you connect the sensor to the transmitter OOM223/253, polarisation is automatically performed after switching on the transmitter.
5. The polarisation time takes about 1 hour.



Note!

Polarisation starts high, then drops gradually. You will recognise the end of polarisation when the display stabilises and remains practically constant.



Caution!

- When you remove the sensor from the medium, protect the sensor from strong sunlight.
- Make sure you comply with the instructions for commissioning and calibration in the Operating Instructions of the transmitter.

6.3 Calibrate

Calibrate the sensor (Calibration in air, → Page 18) immediately after it's polarisation.

The calibration intervals depend heavily on:

- The application and
- The installation position of the sensor.

The following methods help you determine how long the calibration intervals should be:

1. Check the sensor one month after its being put into operation by taking it out of the fluid, drying it and then measuring the oxygen saturation index at air after 10 minutes.
Decide using the results:
 - a. If the measured value is not at 102 ± 2 %SAT, you have to calibrate the sensor.
 - b. Otherwise, double the length of time to the next inspection.
2. Proceed as per Point 1 after two, four and/or eight months. In this way, you can determine the optimum calibration interval for your sensor.



Note!

Be sure to calibrate the sensor at least once a year.

7 Maintenance

Maintenance work must be carried out at regular intervals. To ensure that it is carried out, we recommend you enter the maintenance dates into an operations logbook or in an operations calendar in advance.

The following activities must be carried out:

- Cleaning the sensor
(In particular when the membrane is soiled)
- Check the measuring function:
 1. Remove the sensor from the medium.
 2. Clean and dry the membrane.
 3. After about 10 minutes, measure the oxygen saturation index in air (without recalibration).
 4. The measured value should be near to 102% SAT (display of O₂ saturation with OOM 2x3 by pressing 4 times the  key).
- Replace a defective membrane or one which cannot be cleaned any more.
- Recalibration.



Note!

For regular automatic sensor cleaning, we recommend equipping the measuring point with a fully-automatic cleaning system.

7.1 Cleaning the sensor

The measurement can be corrupted by sensor fouling or malfunction, e.g.:

- Coatings on the sensor membrane
 - ▢ cause longer response times and a reduced slope.
- Soiling or poisoning of the electrolyte
 - ▢ causes longer response times and false measurement.

To ensure reliable measurement, the sensor must be cleaned at regular intervals. The frequency and intensity of the cleaning operation depend on the measuring medium.

Clean the sensor:

- before every calibration
- at regular intervals during operation as necessary
- before returning it for repairs.

Depending on the type of soiling, proceed as follows:

Type of soiling	Cleaning
Salt deposits	Immerse the sensor in drinking water or in 1-5% hydrochloric acid for a few minutes. Afterwards, rinse it with copious amounts of water.
Dirt particles on the sensor body (not on the membrane!)	Clean the sensor body mechanically with water and a suitable brush.
Dirt particles on the membrane cap or the membrane	Clean the membrane with water and a soft sponge.



Caution!

After cleaning, rinse the sensor with copious amounts of clean water.

7.2 Regenerating the sensor

Parts of the sensor will suffer wear and tear during operation. Suitable action can restore normal operating functionality. This action includes:

Action	Cause
Cleaning the cathode	soiled or plated cathode
Replacing the sealing ring	visual damage to the sealing ring
Replacing the electrolyte	unstable or implausible measuring signal or electrolyte soiling
Replacing the membrane cap	uncleanable membrane, damaged membrane (hole or overstretch)



Warning!
Before beginning regeneration, switch off the power supply at the transmitter.

7.2.1 Cleaning the cathode

The cathode only needs to be cleaned when it is visibly soiled or there is a Coating of silver on it.

To clean it, proceed as follows:

1. Unscrew the membrane cap from the membrane body.
2. Carefully clean the surface in two stages with the abrasive sheet (contained in scope of supply) until the (silver) Coating is fully removed. Use the green sheet first and then the yellow sheet.
3. Clean the electrode with drinking or distilled water.
4. Fill the membrane cap with fresh electrolyte OOO 3-F and screw it back onto the membrane body (up to the stop).



Caution!
The **anode** is covered with a silver bromide layer at the factory. **Do not clean the anode under any circumstances!**
If the Coating of the anode is removed as a result of operation, the sensor is unusable and must be sent in for recoating. In this case, contact your sales office.

7.2.2 Replacing the sealing ring

Replacing the sealing ring is only necessary when it is visibly damaged. For replacement, use only the supplied sealing rings OOO 31-OR.

7.2.3 Replacing the electrolyte

The electrolyte OOO 3-F is slowly used up during measuring operations. The cause of this is electrochemical substance reactions. No substance reactions occur in de-energised state and the electrolyte is not used up.

The theoretical life of an electrolyte filling for use in air-saturated drinking water at 20°C is max. 5 years. The electrolyte life is shortened by diffused, dissolved gases such as H²S, NH₃ or high concentrations of CO₂.

Particular loads occur with:

- anaerobic stages (e.g. denitrification)
- strongly polluted industrial wastewater, particularly at high temperatures.

**Warning!**

Risk of acid burns!

The electrolyte is strongly alkaline. You must follow the appropriate occupational safety regulations. Always wear protective gloves and goggles with handling electrolytes.

To replace the electrolyte, proceed as follows:

1. Remove the membrane cap.
2. Replace the electrolyte and, if necessary, the membrane cap.
3. Place the membrane cap back on the membrane body and screw the cap to the stop.

7.2.4 Replacing the membrane cap

Removing the old membrane cap

1. Remove the sensor from the medium.
2. Unscrew the protection basket.
3. Clean the outside of the sensor.
4. Unscrew the membrane cap.
5. If necessary, clean the cathode or replace the sealing ring if it is damaged.
6. Rinse the electrode holder with drinking water.

Installing the new membrane cap

7. Make sure that there are no dirt particles on the sealing surface.
8. Fill the complete contents of a plastic ampoule (containing electrolyte O0Y3-F) into the membrane cap.
9. Remove all the air bubbles in the electrolyte by tapping the side of the membrane cap (e.g. with a pencil).
10. Hold the sensor body **at an angle** and carefully screw the membrane cap onto it **down to the stop**.
11. Screw the protection basket back on.

**Note!**

After replacing the membrane cap, polarise and recalibrate the sensor. Then insert the sensor into the medium and check that no alarm is displayed on the transmitter.

8 Accessories

8.1 Connection accessories

- ☐ VS junction box
 - with plug-in socket and 7-pole plug,
 - for cable extension from sensor (OOS 31, OOS 3 with SXP connector) to transmitter, IP 65;
 - order no. 50001054
- ☐ Measuring cable OMK
 - for use as extension cable between junction box VS and transmitter, not terminated
- ☐ Measuring cable for sensors OOS 31 and OOS 71 with TOP 68 connector
 - OOK 31; length: 1.5 m (4.92 ft)
 - OOK 31; length: 7 m (22.97 ft)
 - OOK 31; length: 15 m (49.22 ft)

8.2 Installation accessories

- ☐ Immersion assembly OOA110
 - for sensor immersion in the basin, PVC pipe resp. PUR floating body with SS 1.4571 (AISI 316Ti) immersion tube;
- ☐ Flow assembly OOA250
 - for sensor installation in pipe lines, PVC;
- ☐ Retractable assembly OOA451
 - Manually driven retractable assembly, stainless steel, with ball valve, for oxygen sensors;
- ☐ Immersion assembly OYA611
 - for sensor immersion in basins, open channels and tanks, PVC;
- ☐ Immersion assembly OOO 105
 - for sensor immersion in basins, SS 1.4404 (AISI 316L) pipe, SS 1.4571 (AISI 316Ti) fitting;
- ☐ Basin rim holder OOO 106
 - for sensor immersion into the basin, SS 1.4301 (AISI 304);
- ☐ Baffle plate OP
 - extra protection for extreme current conditions;
- ☐ Membrane protection basket OOO 3-SK
 - or sensor use in fish ponds;

8.3 Measurement, controlling and sensor cleaning

- ☐ OOM223/253
 - Transmitter with integrated sensor function monitoring, measured value monitoring, free configuration alarm contact, field or control panel installation, HART® or PROFIBUS possible;
 - Ordering acc. to product structure, see Technical Information TI 199e00; order no. 51505694

9 Trouble-shooting

9.1 Trouble-shooting instructions

If any of the following problems occur, test the measuring device as indicated.

Problem	Check	Remedial action
No display, no sensor reaction	Mains voltage to the transmitter?	Connect mains voltage.
	Sensor connected correctly?	Set up correct connection.
	Medium flow available?	Create flow.
	Coating on the membrane?	Clean the sensor.
	Electrolyte in the measuring chamber?	Fill with electrolyte or replace electrolyte.
Displayed value too high	With a TOP 68 connection: humidity or dirt in plug?	Cleaning of the TOP 68 plug-in connection by using cleaning alcohol.
	Polarisation complete?	Wait until polarisation time ends.
	Last calibration with different sensor?	Recalibrate
	Temperature display clearly too low?	Check sensor, if necessary send sensor in for repair.
	Membrane visibly stretched?	Replace membrane cap.
	Electrolyte soiled?	Replace electrolyte.
	Open sensor. Dry electrodes transmitter display now at 0?	Check electrical connection. If the problem still occurs, send the sensor in.
	Anode coating dissolved, is the anode silver instead of brown?	Send in the sensor for recoating.
	Cathode silver-plated?	Clean the cathode.
Displayed value too low	With a TOP 68 connection: Humidity or dirt in plug ?	Cleaning of the TOP 68 plug-in connection by using cleaning alcohol.
	Sensor calibrated?	Recalibrate
	Medium flow available?	Create flow.
	Displayed temperature clearly too high?	Check sensor, if necessary send sensor in for repair.
	Coating on the membrane?	Clean membrane or replace membrane cap.
	Electrolyte soiled?	Replace electrolyte.
Strong deviations in displayed value	Membrane visibly stretched?	Replace membrane cap.
	Open sensor. Dry electrodes transmitter display now at 0?	Check electrical connection. If the problem still occurs, send the sensor in.
	EMC interference on the measuring system?	Remove outer screening of sensor and extension cable at terminal S. Cut measuring and signalling lines from h.v. power lines.

Problem	Check	Remedial action
Membrane breakage alarm	Membrane no longer sealed due to damage?	Replace membrane cap, polarise and calibrate the sensor.
	Membrane outside-to-outside not damaged?	Screw membrane cap tight. If the alarm still occurs: Separate sensor from transmitter for min. 30 seconds. Repeat once or twice, if the alarm remains. If the alarm still occurs: replace membrane cap, polarise and calibrate.
	Sealing ring of membrane cap not clean?	Take the sensor from the medium, clean and dry it. Clean the sealing ring or replace it, if it is damaged. Separate sensor from transmitter for min. 30 seconds. Repeat once or twice, if the alarm remains. If the alarm still occurs: send sensor in for repair.

**Note!**

Make sure you comply with the instructions for troubleshooting in the Operating Instructions of the transmitter. If necessary, carry out a test of the transmitter.

9.2 Sensor checks

**Caution!**

Only authorised and trained personnel may test the sensor!
You will also require a multimeter (voltage, resistance).

Check	Measure	Setpoint
Voltage inspection	With the sensor connected, test the operating voltage on the OOM 223/253 transmitter	between terminals 87 and 0: +8 V between terminals 88 and 0: –8 V
Slope inspection	Place the sensor in the air, and dry with a paper towel.	After 10 minutes: approx. 102% SAT (4 times $\square$)
Zero point inspection	Immerse the sensor in zero solution ¹ .	Display near to 0 mg/l (0% Sat)
	Open the measuring chamber and dry the electrodes.	
Temperature sensor check	Disconnect the sensor and measure the resistance: – between TOP68 pins 3 and 4 – between SXP pins 3 and 4 (with fixed cable version)	depending on temperature: 5 °C: 74.4 k Ω 10 °C: 58.7 k Ω 15 °C: 46.7 k Ω 20 °C: 37.3 k Ω 25 °C: 30.0 k Ω 30 °C: 24.3 k Ω

¹ How to use the zero solution:

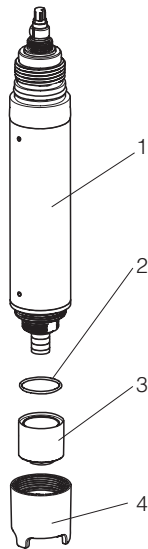
1. Fill a large beaker (1.5 - 2 l) with approx. 1 l of water.
2. Pour a cap-full of the zero solution into the water.
3. Immerse the sensor into the water and wait a sufficient period of time (15 min. for oxygen depletion).
The display drops to around 0 mg/l (0 %SAT).

Depending on the conditions (contact surface water/air), the zero solution is stable for up to 12 hours.

**Note!**

If there are deviations from the reference values, follow the troubleshooting instructions or contact your sales office.

9.3 Spare parts

	Position	Spare parts kit	order no.
 C07-OOS41xxx-09-05-06-xx-001.eps Fig. 20: OOS31	1	Sensor	see product structure
	2	Sealing ring OOS31-OR – Material: Viton – 3 pieces	on request
	3	Membrane cap – Replacement cartridge OOS31-WP for normal response time – 2 preterminated replacement cartridges with pretensioned membrane	on request
		Membrane cap – Replacement cartridge OOS31S-WP for fast response time – 2 preterminated replacement cartridges with pretensioned membrane	on request
	4	Membrane protection basket	on request
	without fig.	Electrolyte OOS3-F – 10 plastic ampoules, transparent	on request
		Polishing sheets OOS3-PF – for cathode cleaning – 10 pieces	on request
		Zero solution – 3 units to produce 3 x 1 litre oxygen free solution	on request
	2-4	Accessories kit OOS31-Z, one of each: – Electrolyte OOS3F – Replacement cartridge OOS31-WP for normal response time – Sealing ring OOS31-OR – Polishing sheet OOS3-PF	on request
		Accessories kit OOS31-S-Z, one of each: – Electrolyte OOS3F – Replacement cartridge OOS31S-WP for fast response time – Sealing ring OOS31-OR – Polishing sheet OOS3-PF	on request

9.4 Return

If the device requires repair, please send it *cleaned* to the sales centre responsible. Please use the original packaging, if possible.

Please enclose the completed "Declaration of contamination" (copy the second last page of these Operating Instructions) with the packaging and the transportation documents.
No repair without completed "Declaration of contamination"!

9.5 Disposal

The device contains electronic components and must therefore be disposed of in accordance with regulations on the disposal of electronic waste.
Please observe local regulations.

10 Technical data

10.1 Input

Measured value	dissolved oxygen [mg/l / % SAT / hPa]
Measuring range	with OOM223/253: 0.05 ... 60.00 mg/l 0.00 ... 600 % SAT 0 ... 1200 hPa

10.2 Performance characteristics

Response time	• OOS31-XXX1 (membrane cap for normal response time): – T₉₀: 3 minutes – T₉₉: 9 minutes (each at 20 °C) • OOS31-XXX2 (membrane cap for fast response time): – T₉₀: 0.5 minutes – T₉₉: 1.5 minutes (each at 20 °C)
Slope	approx. 300 nA (at 20 °C, 1013 hPa)
Polarisation time	< 60 minutes
Minimum flow rate	for 95 % of measured value display: • OOS31-XXX1: typical 0.5 cm/s • OOS31-XXX2: typical 2.5 cm/s
Drift	with permanent polarisation: < 1 % per month
Zero current	zero current free
Sensor monitoring	with OOM 223/253: cable interruption or short-circuit incorrect measurement and sensor passivation

10.3 Environment

Storage temperature	filled with electrolyte: –5 ... 50 °C (23 ... 122 °F) without electrolyte: –20 ... 60 °C (–4 ... 140 °F)
Ingress protection	IP 68

10.4 Process

Process pressure	max. 10 bar (145 psi) permissible overpressure Underpressure operation is not permissible.
Process temperature	–5 ... 50 °C (23 ... 122 °F)

10.5 Mechanical construction

Design, dimensions	see chapter "Installation"	
Weights	with cable length 7 m (22.97 ft): 0.7 kg (1.5 lb.) with cable length 15 m (49.22 ft): 1.1 kg (2.4 lb.) with TOP68 plug-in connection: 0.3 kg (0.7 lb.)	
Materials	Sensor shaft: Membrane cap: Cathode: Anode:	stainless steel 1.4571, AISI 316Ti POM Gold Silver / Silver bromide
Process connections	G1	
Cable entry (sensor)	Fixed cable or TOP68 plug-in connection	
Cable entry (transmitter)	• SXP plug (field device) • Terminal connection (panel mounted device)	
Cable length incl. extension cable	max. 100 m / 328.1 ft (including cable extension)	
Temperature compensation	NTC temperature sensor 30 k Ω at 25 °C (77 °F), 0 ... 50 °C (32 ... 122 °F)	
Membrane thickness	• OOS31-XXX1: approx. 50 μm • OOS31-XXX2: approx. 25 μm	

Index

A

Accessories

Baffle plate	25
For cleaning	25
For connection	25
For installation	25
Measurement, controlling and cleaning	25
Membrane protection basket	25

Amperometric principle	17
----------------------------------	----

Angle of installation	8
---------------------------------	---

B

Baffle plate	25
------------------------	----

Basin rim holder	11
----------------------------	----

C

Cable connection	31
----------------------------	----

Cable length	31
------------------------	----

Calibration	21
-----------------------	----

Calculating the calibration value	18
---	----

General	17
-------------------	----

In air	18
------------------	----

Chain assembly	10
--------------------------	----

Checking	
--------------------	--

Connection	15
----------------------	----

Function	20
--------------------	----

Installation	13
------------------------	----

Cleaning	
--------------------	--

Gold cathode	23
------------------------	----

Sensor	22
------------------	----

Commissioning	4, 20
-------------------------	-------

D

Designated use	4
--------------------------	---

Dimensions	7
----------------------	---

Disposal	29
--------------------	----

Drift	30
-----------------	----

E

Electrical connection

Direct connection	14
-----------------------------	----

Via junction box	15
----------------------------	----

Environment	30
-----------------------	----

Errors	26
------------------	----

F

Floating body	12
-------------------------	----

Flow operation	12
--------------------------	----

I

Icons	5
-----------------	---

Immersion operation	10
-------------------------------	----

Incoming acceptance	7
-------------------------------	---

Input	30
-----------------	----

Installation	4, 7–8
------------------------	--------

Angle of	8
--------------------	---

Check	13
-----------------	----

Examples	10
--------------------	----

Flow operation	12
--------------------------	----

Immersion operation	10
-------------------------------	----

Measuring point	9
---------------------------	---

Place	8
-----------------	---

Retractable assembly	13
--------------------------------	----

M

Maintenance	22
-----------------------	----

Measuring point	9
---------------------------	---

Measuring principle	17
-------------------------------	----

Measuring system	8
----------------------------	---

Mechanical construction	31
-----------------------------------	----

Membrane	17
--------------------	----

Membrane protection basket	25
--------------------------------------	----

O

Operation	4
---------------------	---

Operational safety	4
------------------------------	---

Ordering information	6
--------------------------------	---

P

Performance characteristics	30
---------------------------------------	----

Polarisation	17, 20
------------------------	--------

Process	30
-------------------	----

Product structure	6
-----------------------------	---

R

Regenerating	23
------------------------	----

Replacing

Electrolyte	23
-----------------------	----

Membrane cap	24
------------------------	----

Sealing ring	23
------------------------	----

Retractable assembly	13
--------------------------------	----

Return	4, 28
------------------	-------

S

Safety icons	5
------------------------	---

Scope of delivery	6
Sealing ring	23
Sensor	
Checks	27
Design	16
Dimensions	7
Regenerating	23
Spare parts	28
Storage	7
Storage temperature	30
Symbols	5

T

Technical data	30
Environment	30
Input	30
Mechanical construction	31
Performance characteristics	30
Process	30
Transport	7

U

Upright post	10
Use	4

W

Weight	31
------------------	----

Z

Zero current	30
------------------------	----

Declaration of contamination

Dear customer,

Because of legal determinations and for the safety of our employees and operating equipment, we need this "Declaration of contamination" with your signature before your order can be handled. Please, include the completely filled in declaration with the device and the shipping documents in any case. Add also safety sheets and / or specific handling instructions if necessary.

Type of device / sensor:	_____	Serial no.:	_____
Medium / concentration:	_____	Temperature:	_____ Pressure: _____
Cleaned with:	_____	Conductivity:	_____ Viscosity: _____

Warning hints for medium used (mark the appropriate hints)



☐
radioactive



☐
explosive



☐
caustic



☐
poisonous



☐
harmful to
health



☐
biologically
hazardous



☐
inflammable



☐
safe

Reason for return

Company data

Company:	_____	Contact person:	_____
	_____		_____
Address:	_____	Department:	_____
	_____	Phone:	_____
	_____	Fax / e-mail:	_____
		Your order no.:	_____

I hereby certify that the returned equipment has been cleaned and decontaminated acc. to good industrial practices and is in compliance with all regulations. This equipment poses no health or safety risks due to contamination.

(Place, date)

(Company stamp and legally binding signature)

BA285e/00//04.04
Printed in Germany / FM+SGML 6.0 / DT



51506569